2.15 Isothermal compressibility

The thermodynamic quantities defined so far are all based on the Gibbs function itself and its first derivatives. The remaining quantities discussed in this section all involve higher order derivatives.

The isothermal and isohaline compressibility of seawater κ^t is defined by

$$\kappa^t = \kappa^t\left(S_\mathrm{A},t,p\right) = \rho^{-1}\left.\frac{\partial\rho}{\partial P}\right|_{S_\mathrm{A},T} = -v^{-1}\left.\frac{\partial v}{\partial P}\right|_{S_\mathrm{A},T} = -\frac{g_{PP}}{g_P} \qquad (2.15.1)$$

where the second derivative of g is taken with respect to pressure (in Pa) at constant S_A and t. The use of P in the pressure derivatives in Eqn. (2.15.1) serves to emphasize that these derivatives must be taken with respect to pressure in Pa not in dbar. The isothermal compressibility of seawater κ^t produced by both the SIA and GSW computer software libraries (appendices M and N) has units of Pa^{-1}.

2.16 Isentropic and isohaline compressibility

When the entropy and Absolute Salinity are held constant while the pressure is changed, the isentropic and isohaline compressibility κ is obtained:

$$\begin{aligned}\kappa = \kappa\left(S_\mathrm{A},t,p\right) &= \rho^{-1}\left.\frac{\partial\rho}{\partial P}\right|_{S_\mathrm{A},\eta} = -v^{-1}\left.\frac{\partial v}{\partial P}\right|_{S_\mathrm{A},\eta} = \rho^{-1}\left.\frac{\partial\rho}{\partial P}\right|_{S_\mathrm{A},\theta} = \rho^{-1}\left.\frac{\partial\rho}{\partial P}\right|_{S_\mathrm{A},\Theta} \\ &= \frac{\left(g_{TP}^2 - g_{TT}\,g_{PP}\right)}{g_P\,g_{TT}}\,.\end{aligned} \qquad (2.16.1)$$

The isentropic and isohaline compressibility κ is sometimes called simply the isentropic compressibility (or sometimes the "adiabatic compressibility"), on the unstated understanding that there is also no transfer of salt during the isentropic or adiabatic change in pressure. The isentropic and isohaline compressibility of seawater κ produced by both the SIA and GSW software libraries (appendices M and N) has units of Pa^{-1}.